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INTERNATIONAL COOPERATION IN THE PEACEFUL USES OF OUTER SPACE: ACTIVITIES OF MEMBER STATES

Note by the Secretariat

Addendum

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INTRODUCTION

1. Documents A/AC.105/567 and Add.1-4 contain information received from Member States as of 15 December 1993 on the following topics, pursuant to a recommendation made by the Committee on the Peaceful Uses of Outer Space at its thirty-sixth session:[1]

(a) Those space activities that were or could be the subject of greater international cooperation, with particular emphasis on the needs of the developing countries;

(b) Spin-off benefits of space activities.

2. The present document contains information on those topics that was received from Member States since 1 March 1994.

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[1]Official Records of the General Assembly, Forty-eighth Session, Supplement No. 20 (A/48/20), para. 122.

REPLIES RECEIVED FROM MEMBER STATES*

PAKISTAN

[Original: English]

1. Introduction

1.1 Space research in Pakistan is conducted by the Pakistan Space & Upper Atmosphere Research Commission (SUPARCO), which was established through a Presidential Ordinance in May 1981 as a successor to the Pakistan Space & Upper Atmosphere Research Committee which was founded in September 1961. SUPARCO's charter was later duly passed by the National Assembly and Senate and signed by the State President in 1987. In its current form SUPARCO enjoys the status of a national organization with a high degree of autonomy.

1.2 A high-powered Space Research Council (SRC),headed by the Prime Minister of Pakistan,was formed to establish policy guidelines and direct the country's space programme. The Executive Committee of the Space Research Council (ECSRC) was also constituted simultaneously to monitor, on behalf of the SRC, the progress of the space programme executed by SUPARCO.

1.3 Pakistan's space programme is broadly aimed at furthering research in space science and allied fields, developing indigenous capabilities in space technology and promoting the applications of space science and technology for the socio-economic improvement of the country. SUPARCO's expanding research and applications programmes cover a diverse range of fields, such as neutral atmosphere studies; satellite meteorology; remote sensing applications; satellite communications; ground receiving stations; designing/assembling of rockets and experimental satellites and related instrumentation; ionospheric physics; radio wave propagation; geomagnetism; satellite geodesy; astronomy and computer support.

2. Research and Applications Programmes

Remote Sensing Applications

2.1 Remote sensing concerns the collection of information related in some way to the Earth's natural resources or environment. Data are collected primarily by satellite and aircraft systems in conjunction with localized ground-based surveys and measurements. The data are then processed by digital computer or optical techniques to extract information of value to scientists and resource and environment managers.

2.2 The multi-disciplinary satellite remote sensing (SIRS) applications programme had been continuing since 1973 and a full-fledged national Remote Sensing Applications Centre, RESACENT, had been working at Karachi since 1978. RESACENT is responsible for liaison with national/foreign agencies, development of visual analysis and digital image processing facilities and conduct of research studies in a wide variety of application areas including water resources/hydrology, agriculture, forestry, geology/geomorphology, regional and urban land use, environment, establishment of a geographic information system (GIS) etc.

2.3 SUPARCO is also the national coordinator for remote sensing activities, in which capacity it acquires and archives SIRS data of Pakistan, supplies the data to user agencies, provides technical assistance to these

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*The replies are reproduced in the form in which they were received.

agencies in the use of data, conducts collaborative research projects with them and organizes training courses, workshops, seminars, symposia, etc. at the national and international levels.

Data Interpretation Facilities

2.4 SUPARCO's Remote Sensing Applications Centre (RESACENT) has adequate facilities for visual and digital analysis of SIRS data. Visual interpretation equipment includes density slicer, colour additive viewer, zoom transferscope, zoom stereoscope and other aids. There is also a well equipped photographic laboratory. Digital processing/analysis facilities include a dedicated microprocessor-based image processing system, called EBBA-II. Digital facilities were further enhanced with the addition of a Micro VAX II computer and a GPX-II workstation. A Local Area Network (LAN), with eight user terminals and the GPX-II, is being established around the Micro VAX II. Various peripherals such as tape drives, plotter, thermal colour copier and digitizer have been hooked to the host computer. The PC-based ERDAS image processing system and the ARC/INFO GIS was installed at the Centre.

Application Studies

2.5 Some of the important studies conducted during the period under review are:

- Use of NOAA High Resolution Picture Transmission (HRPT) data to complete the data bank for Monitoring Vegetal Cover project
- Mapping of Forests in the Margala Hills
- Monitoring Desertification in Pakistan
- Snow Cover Estimation for River Run-off Forecasting
- Estimation of 1992 Flood Inundation
- Assessing Crop Area Damage Caused by 1992 Floods
- Estimation of Crop Area Damaged in Sindh due to 1992 Monsoon
- Mapping of Biomass and other Terrain Units in Sanghar District
- Digital Processing and Enhancement Techniques Applied to SPOT Data of Pishin District for Landcover Mapping
- Mapping and Monitoring of Land Accretion/Erosion and sediment Distribution

Satellite Ground Station

2.6 SUPARCO's Satellite Ground station (SGS) at Islamabad acquires Landsat, SPOT, and NOAA satellite data. The SGS, which became fully operational in 1989, is one of the most advanced and sophisticated stations in the Asia-Pacific Region. The photographic and digital data products generated at the station cover successive levels of radiometric and geometric corrections, satisfying the most widely varying user requirements. The geometric quality of its data products is exceptionally high.

2.7 The SGS covers, in addition to Pakistan, a large number of neighboring countries, wholly or partially. It is, in fact, the only ground receiving station that can cover some parts of Western China, Western Mongolia and many of the newly independent countries of Central Asia, such as Kazakhstan, Uzbekistan, Tadjikistan, Kirgystan, Turkmenistan, and Azerbaijan.

2.8 The Satellite Ground Station acquired up to 30 June 1993 approximately 21,430 Landsat Thematic Mapper (TM) scenes, 5,358 Landsat Multiple Spectral Scanner (MSS) scenes, 6,850 SPOT multispectral scenes and 7,841 SPOT panchromatic scenes. From them, about 2,890 Computer Compatible Tapes (CCTs), 1,938 black and white and colour films and 2,200 B/W and colour prints at various scales were generated for various user agencies or for use within SUPARCO.

2.9 The SGS disseminates Landsat, SPOT and NOAA data products to local and foreign user agencies for a variety of application studies. SIRS data provided by SUPARCO were used by about 60 other user departments/organizations in Pakistan, for a wide variety of applications in various scientific disciplines.

2.10 The Station's upgrading for reception of data from Landsat-6 and ERS-I satellites is also under consideration.

Satellite Communications

2.11 The establishment of a domestic telecommunications satellite system, PAKSAT, is the long-term aim of Pakistan's national space agency. The intention is to position two Ku-band PAKSATs at 38°E and 41°E (in-orbit spare) by the late 1990s, although funding constraints could delay the programme. In order to establish the necessary infrastructure for implementation of the PAKSAT project, several activities were carried out which included (a) design and development of low-cost, low Earth orbit spacecraft (BADR-I), and (b) installation, operation, and maintenance of ground receiving stations for tracking and reception of low Earth as well as geostationary satellites.

2.12 The second meeting of the Committee on Communication Satellite System constituted by the ECSRC was held on 15 October, 1992. It was decided to invite tenders from private sector organizations to implement the project on self-financing basis. The Revised Tender Invitation was finalized by the Minister of State and Chief Executive of the Pakistan Investment Board (PIB). The Draft Tender Invitation was then forwarded to Finance Minister and its clearance was awaited.

Pakistan's Second Experimental Satellite, BADR-B

2.13 Development of space infrastructure was started in SUPARCO with the indigenous design and development of low-cost LEO satellites for communications and remote sensing applications. The 52 kg BADR-1 with a store and forward payload was launched on 16 July 1990 by China's CZ-2E rocket. The tracking, telemetry and control was provided from SUPARCO's Karachi campus, supported by the station at Lahore.

2.14 Pakistan's Second Experimental Satellite, BADR-B is being developed by SUPARCO as part of its Satellite Technology Programme. The project envisages development and fabrication of engineering and flight models of BADR-B, and augmentation of testing and integration facilities. The programme includes installation and commissioning of tracking, telemetry, and control (TT&C) station. BADR-B is being planned to be placed into a sun-synchronous circular orbit of around 700 km altitude as piggyback from a foreign launcher. BADR-B will help in the further development of infrastructure for the design of low-cost small satellites and encourage participation of the country's academic and scientific community in the applications of small satellites.

2.15 Design and development work on various systems and payload elements accomplished so far includes:

- Housing and Structure of the Engineering Model
- Engineering Model of Battery Charge Regulator of the Power System
- UHF antennas, VHF antenna, antenna feed network, duplexer and one each of VHF transmitter and UHF receiver
- Engineering Model of Telemetry Subsystem
- Software to assemble package for Store and Forward Experiment
- Earth imaging payload (using a low resolution CCD sensor) with 64 gray level hardware/software capability.

Direct Broadcast Satellite Receiver (DBSR)

2.16 SUPARCO continued to manufacture S-band and C-band systems for direct reception of TV programmes using 2.5 m, 3.6 m and 6.1 m antennae.

Satellite Tracking Stations

2.17 An S-band Tracking, Telemetry and Control facility for LEO satellites is being established at Lahore. To acquire the necessary hardware/software services, a contract was awarded to M/s Alcatel of France. Besides a number of satellites operating in VHF/UHF and S-band, the facility will be used to track, receive, and control SUPARCO's second experimental satellite, BADR-B.

Information Retrieval System

2.18 SUPARCO has established an Information Retrieval System through on-line access to the European Space Agency's Information Retrieval Service (ESA-IRS) and has been in regular use since 1987. ESA-IRS has over 200 databases covering almost all fields connected with space.

COSPAS-SARSAT Programme

2.19 Pakistan's Local User Terminal (PALUT)/Pakistan Mission Control Centre (PAMCC) continued to function normally. Interference monitoring in the 406 MHz band was carried out on a continuous basis. The PAMCC is now automatically transmitting alert and location data to the Civil Aviation Authority and the countries of the region. PAMCC is now integrated into the COSPAS-SARSAT network through the Control Mission Centre in Russia. The COSPAS-SARSAT Council has accepted inclusion of PALUT/PAMCC in its world-wide network.

2.20 A number of distress signals were received, processed and information relayed to the Rescue Coordination Centre, Lahore, and Maritime Security Agency, Karachi. After the installation of a second telex, PAMCC was fully integrated with international networks and attained initial operational capability (IOC).

2.21 A report on the installation and commissioning of a 406 MHz COSPAS-SARSAT beacon test and certification facility was submitted to the COSPAS-SARSAT Council. The report included a request to include the facility in the list of facilities accepted for type approval.

2.22 The design and development phase of 121.5 MHz and 243 MHz Energy Locator Transmitters (ELT) was completed. The 121.5 MHz beacon already developed was packaged for various applications. Subsequent to the development of 121.5 MHz and 243 MHz ELTs, PIA indicated their willingness to allow carriers to conduct evaluation exercises for field proving. The beacons were readied for the test.

2.23 The Beacon Certification Test Bench Facility was working normally and was being used for development work of 121.5 MHz, 243 MHz and 406 MHz beacons as well as radiosonde.

Space Science anal Atmospheric Research

2.24 SUPARCO's space science and neutral atmosphere research programme includes satellite radiance studies, atmospheric pollution monitoring studies, satellite meteorology based on the use of NOAA APT images, TIROS Operational Vertical Sounder (TOVS) Receiving/Processing System, use of satellites for collection of meteorological, hydrological and environmental data from unattended remote data collection platforms (DCPs), satellite geodesy and ionospheric research.

Atmospheric Pollution Monitoring Studies

2.25 SUPARCO's Atmospheric Pollution studies involving monitoring of various air pollutants continued to be made at Karachi. SUPARCO's air pollution group collected marine aerosol and ozone data during an Arabian sea cruise. On the request of Pakistan Steel, collection of data on Total Suspended Particulates (TSP) and particulates < 10 micrometer was made at the premises of Pakistan Steel.

2.26 A project of SUPARCO titled, "Study of Atmospheric Pollution in the Antarctic Region," was included in the Pakistan's Antarctic Expedition II. Under this project, the Ozone and Nitrogen Oxide concentrations at Jinnah Station, Antarctica, were monitored during the Antarctic Expedition.

2.27 Marine aerosol and sea water samples were collected during a 12-day NASEER-II Cruise programme organized by the National Institute of Oceanography.

2.28 The following studies were conducted in the field of environmental pollution monitoring:

-- Use of Satellite Data in Air-Sea Interaction Studies
-- Quality of Marine Air over the Open Northern Arabian Sea
-- Surface Ozone and Aerosol Measurements over the Northern Arabian Sea during the 1992 Summer Monsoon
-- Health Effects of Global Climate Change

Automatic Picture Transmission (APT) Station

2.29 The APT Station established at the Space Research Centre (SPARCENT), Karachi, in 1988 continued to provide, on a routine basis, NOAA's thermal infrared (TIR) images of Pakistan and surrounding areas and the temperature data at related locations.

TIROS Operational Vertical Sounder (TOVS) Receiving/Processing System

2.30 A ground receiving station for acquisition and processing of TIROS Operational Vertical Sounder (TOVS) data from NOAA series of satellites was installed at SPARCENT, Karachi, in 1992. The data will be processed to determine atmospheric vertical temperature and water vapour profiles from the surface to the stratosphere. Statistical analysis was carried out for total ozone content present in the vertical column, acquired through the TOVS system and the ground-based ozone data in Karachi.

2.31 A "Monsoon Watch 1993" programme based on the available satellite information through TOVS, APT, ARGOS etc. was initiated. Three months of TOVS data of the Karachi, Multan, and Islamabad areas were provided to user agencies.

ARGOS (Satellite--Based Environmental Data Collection Network) Programme

2.32 Environmental data from the ARGOS Data Collection Platforms (DCPs) of remote sites in Pakistan were regularly being supplied to various national user agencies. Data from other DCP's were also being received at SUPARCO's Direct Readout Station. A study to establish some correlation between APT and ARGOS (in-situ) temperatures measurements was also undertaken.

Ionospheric and Geomagnetic Research

2.33 SUPARCO is presently operating three ground stations, one each at Islamabad, Karachi and Multan, to measure the heights of various electron layers in the ionosphere. These three stations operate 24 hours per

day to keep a tab on the ionosphere without which there would be no high frequency radio communications linking national as well as international stations. Bulletins containing predictions for Maximum Usable Frequency (MUF) and Optimum Traffic Frequency (FOT) and geomagnetic data were regularly issued to various national user agencies.

2.34 An Automatic Magnetic Observatory System (AMOS-III) was also working at Karachi for measuring and recording geomagnetic data which are used in various related studies.

3. Training/Seminars/Workshops/Conferences

Local/Foreign Training Programme/Seminars/ Workshops Sponsored/Co-Sponsored by SUPARCO

3.1 In-house orientation courses covering a wide range of subjects related to space science and technology for different batches of newly recruited scientists and engineers are conducted by SUPARCO. The following training course was organized by SUPARCO during the period under review:

- A Short Course on "Satellite-Aided Search and Rescue Operations" was organized jointly by SUPARCO and Inter-Islamic Network on Space Sciences (ISNET) from 19-23 July, 1992 at Lahore. Three experts from the COSPAS-SARSAT Parties gave lectures in the areas of their expertise and acted as resource persons for over 30 participants to the Course.

Foreign Training Programme

3.2 Two engineers/scientists were sent abroad for higher studies under the Ministry of Science and Technology's Programme of Human Resources Development in High-Tech fields. One scientist proceeded abroad for higher studies on a scholarship offered by a foreign university.

4. International Conferences/Meetings Attended by SUPARCO Scientists and Engineers

4.1 SUPARCO scientists/engineers attended the following conferences/meetings during 1992-93:

- The first meeting of the International Programme Committee (IPC) for Asia-Pacific Workshop on Multilateral Cooperation in Space Technology and Application.s held in Beijing from 7-12 July, 1992.

- United Nations International Seminar for Developing Countries held during the XVII Congress of International Society for Photogrammetry and Remote sensing (ISPRS) at Washington D.C., USA from 2-14 August, 1992.

- Conference on Satellite Remote Sensing for Resource Management, Environmental Assessment, and Global Change Studies: Needs and Applications of Developing Countries organized by the UN Office for Outer Space Affairs and the Government of the United States of America and the Consortium for International Earth Science Information Network at Boulder, Colorado, USA from 17-20 August, 1992.

- UN/IAF/COSPAR/AIAA Symposium on "Space Technology in Developing Countries--Making it Happen," at Washington, DC, USA from 2830 August, 1992.

- World Space Congress and the 29th COSPAR Plenary Meetings and the 43rd Congress of the International Astronautical Federation (IAF) held at Washington, USA from 28 August-5 September 1992.

-- SUPARCO scientists and engineers visited the Russian Academy of Sciences, Russian Space Agency and institutions responsible for planning, development, manufacturing of space related projects in Russia from 1-9 November, 1992.

-- The First Asia-Pacific Workshop on Multilateral Cooperation in Space Technology and Applications jointly organized by China (International Exchange Centre for Space Science & Technology); Pakistan (SUPARCO); and Thailand (Ministry of Transport & Communication) in Beijing from 30 November - 5 December 1992.

-- ESCAP/Asian Development Bank Seminar on "Remote Sensing and GIS Application to Development" held at Manila, Philippines, from 2-4 December, 1992.

-- Ninth Session of the COSPAS-SARSAT Council of the International Search and Rescue Agency, held in London from 7-9 December, 1992.

-- 30th Session of the Scientific and Technical Sub-Committee of the UN Committee on the Peaceful Uses of Outer Space (COPUOS) held at United Nations Headquarters, New York, USA from 16-26 February, 1993.

-- 3rd Session of the Group of Governmental Experts to Carry Out a Study on the Application of Confidence Building Measures in Outer Space held at UN Headquarters, New York from 1-12 March, 1993.

-- Annual Meeting of the Directors of the Remote sensing Centres/Programmes in the ESCAP Region and the 9th Session of the Inter-governmental Consultative Committee (ICC) on the ESCAP Regional Remote sensing Programme (RRSP), hosted and organized by SUPARCO at Islamabad from 8-12 May, 1993.

-- 36th Session of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) held at the United Nations Headquarters, New York, USA from 7-18 June, 1993.

5. Collaboration Between SUPARCO and Universities

5.1 Under the continuing collaboration between SUPARCO and the University of Karachi, SUPARCO continued to provide teaching support to the University in courses relating to space science and remote sensing at the Master's level. Under similar collaborative arrangements, SUPARCO scientists delivered lectures on Space Science to B.Sc. and M.Sc. students of the Department of Space Science of the University of the Punjab, Lahore. SUPARCO scientists also gave lectures on remote sensing to Master's degree students at the departments of Geography and Geology and Environmental and Management Science of the Universities of Karachi and Peshawar.

6. International Cooperation

6.1 SUPARCO cooperates and interacts with various foreign national and international space agencies in the exchange of technical information, provision of data, consultancy services, training activities and collaborative studies in areas of mutual interest.

6.2 Japan's Space Agency (NASDA) has confirmed acquisition of six scenes required under the JERS-1 Verification Programme for SUPARCO's project titled "Investigation for Ancient River Channels as probable Source of Ground Water in Cholistan Desert."

6.3 Under the new agreement with the Earth Observation Satellite (EOSAT) Company, USA, SUPARCO will pay a greatly reduced access fee and would have exclusive rights to sell Landsat data within its footprint (coverage zone) free of any royalty obligations, etc.

6.4 A SUPARCO delegation visited the Russian Academy of Science, Russian Space Agency and institutions responsible for planning, development, manufacturing of space related projects from 1-9 November, 1992 for discussing the development of facilities for design, manufacturing and supply of attitude control subsystems (ACS) for satellites and availability of services for the piggy-back launch of the BADR-B satellite.

6.5 A Memorandum of Understanding was signed by Pakistan (SUPARCO), China (Ministry of Aero-Space Industry) and Thailand (Ministry of Transport and communication) for holding jointly the first Asia-Pacific Workshop on Multilateral Cooperation in Space Technology and Applications in China from 30 November - 5 December 1992. Several recommendations were made at the Workshop. The second Workshop will be held in Thailand and the third Conference will be organized in Pakistan at the end of 1994 or in early 1995, as stipulated in the MOU.

6.6 SUPARCO's delegation proceeded on 28 March, 1993 to Russia for a week-long visit to the Russian Space Agency, Moscow, to explore the possibility of cooperation between the two organizations in the various disciplines of space science and technology.

6.7 The first Asia-Pacific Workshop on Multilateral Cooperation in Space Technology and Applications (APMCSTA) jointly organized by China, Pakistan and Thailand in Beijing in November-December 1992 established a Liaison Committee for APMCSTA with China as its coordinator. One of the tasks of the Liaison Committee was to identify and recommend the potential multilateral cooperation projects, formation of the Project Coordination Committees and Working Groups on various projects of common interest. The Government of Pakistan is represented by a Senior Scientist of SUPARCO on the Liaison Committee. He attended the first meeting of the Liaison Committee held in Beijing from 10-12 May, 1993.

6.8 Four projects of common interest were identified at the first meeting of Liaison Committee:

(i) Small Satellite Technology;
(ii) Satellite Disaster Mitigation System;
(iii) Remote Sensing Satellite Technology/Applications; and
(iv) Communication Satellite Technology/Application.

China is the Coordinator for the first two projects, while Pakistan will serve as Coordinator for the fourth project.

6.9 The French National Space Agency (CNES) has offered to SUPARCO to participate in their S-80/T satellite project for which Government approval was solicited.

6.10 A three-memoer team of Professors from the National University of Singapore visited SUPARCO, on the advice of SPOT IMAGE, to familiarize themselves with SUPARCO's remote sensing facilities and to seek SUPARCO's views on their plans to establish remote sensing facilities and a satellite ground receiving station in Singapore.

6.11 An official of SPOT IMAGE visited SUPARCO and discussed, among other matters, the modified version of the new proposed Agreement for Reception and Distribution of SPOT Data.

6.12 The contract for upgrading the Satellite Ground Station (SGS), Islamabad, for reception and processing of Landsat-6 Enhanced Thematic Mapper (ETM) data was signed with M/s MacDonald Dettwiller

Associates (MDA), Canada. As per terms of the contract, the equipment will be shipped by June 1994. In addition to routine Landsat-6 data acquisition and processing, SGS will attain a capability to generate ETM data using SPOT stereo pairs and a number of new Landsat data products.

7. International/Regional Organizations

7.1 The United Nations Committee for Peaceful Uses of Outer Space (UN-COPUOS) along with its two Subcommittees, has been playing an extremely useful role in international space affairs by providing a forum to exchange views and to discuss developments, issues and matters relating to outer space activities of Member States. The Legal Subcommittee is instrumental in drawing up a body of space law governing the peaceful exploration and utilization of outer space. The Scientific and Technical Subcommittee is involved in promoting international cooperation on space projects.

7.2 As a member of the UN-COPUOS, Pakistan has regularly participated in the annual sessions of the Committee and its subcommittees. Pakistan has been making a regular voluntary contribution during the past several years in support of the UN Space Applications Programme and has made a cash contribution of US $15,000 for the year 1992.

7.3 SUPARCO is also an adhering member to the Committee on Space Research (COSPAR) of the International Council of Scientific Unions (ICSU). In this capacity, SUPARCO participated in the COSPAR Biennial Plenary Meetings and Associated Symposia, Workshops, etc.

7.4 The International Astronautical Federation (IAF) is the society of several space agencies and space firms. Pakistan is a voting member of IAF.

7.5 Pakistan is also a Member State of the Economic and Social Commission for Asia and the Pacific (ESCAP). SUPARCO has been actively participating in UNDP/ESCAP Regional Remote Sensing Programme (RRSP) for development of remote sensing capabilities in the ESCAP region. Senior SUPARCO scientists have also been attending the meetings of the Directors of the Remote Sensing Centre/Programmes of the countries of the Inter-governmental Consultative Committee (ICC) of the RRSP. SUPARCO also functions as the national Contact Point in Pakistan for Education and Training and for the Regional Information Service (RIS) of the RRSP.

7.6 The Annual Meeting of the Directors of Remote Sensing Centres/Programmes in the ESCAP region and the 9th Session of the Intergovernmental Consultative Committee (ICC) on the ESCAP Regional Remote Sensing Programme (RRSP) were hosted/organized by SUPARCO from 8-12 May, 1993 at Islamabad. Pakistan/SUPARCO was the current Chairman of ICC. A total of 40 participants, representing 23 countries and international and regional organizations/institutions attended. Several conclusions and recommendations were formulated at both the Directors Meeting and the ICC Session.

7.7 As a member of the South Asian Association for Regional Cooperation (SAARC), Pakistan participated in the meetings of the SAARC Scientific and Technical Committee for promoting cooperation among the members of the Association in various fields of science and technology, including remote sensing.

7.8 Pakistan is also represented in the World Meteorological Organization (WMO), the International Telecommunication Union (ITU), INTELSAT, INMARSAT, the World Conservation Union (IUCN) and Asian Association of Remote Sensing (AARS).

8. **Activities Considered Suitable for Greater International Cooperation**

8.1 The space activities which should be the subject of greater international cooperation, keeping in view the needs of the developing countries, should include:

(a) Technical cooperation for transfer of technology, mutual exchange of experts and provision of consultancy services and training opportunities in the following areas:

(i) Remote sensing applications to Earth resources survey and environmental studies (training of personnel in various disciplines of remote sensing technology and applications, sensors development for space segment, aerial remote sensing, software, use of satellite remote sensing data for development of GIS;

(ii) Operation, maintenance and licensing of remote sensing satellite ground stations and coordination in remote sensing space segments; establishment of interpretation facilities including hardware and software systems, etc;.

(iii) Development of satellites and their launching, interface with terrestrial communication infrastructure, software and hardware aspects of Direct Broadcasting Satellite (DBS), free or subsidized availability of television/telephone transponders on satellites for promotion of education, health care and communications, particularly in rural areas of developing countries; construction, launch, and operation of the Microsat/LEO satellite network and related ground equipment, etc;

(iv) Space meteorology (development of data processing software, meteorological sensor development, establishment of high resolution picture transmission (HRPT) stations for data reception and processing, fabrication of data collection platforms (DCPs), training of personnel in the area relating to space meteorology;

(v) COSPAS-SARSAT--an international satellite-based search and rescue system (Establishment and Operation of Local User Terminals and Mission Control Centre; design and development of beacons etc.);

(b) Provision of assistance to the developing countries in the form of consultations for rendering advice in preparation of project proposals, installation, commissioning and maintenance of the equipment and making available the satellite transponders for communication and television broadcast services on long-term basis;

(c) Establishment of centralized data banks accessible through computer terminals and provision of improved information exchange service in the form of physical exchange of technical documentation;

(d) Holding of joint meetings of space scientists and technologists of the developing and developed countries for joint planning of scientific missions and general dissemination of scientific data to the developing countries. Exchange of visits and consultancy on some specific aspects such as equipment design, fabrication and maintenance, application projects, joint system studies, technology development, as well as software design and development;

(e) Creation of mechanisms for assuring international availability of space-derived data in fields such as meteorology, remote sensing etc.

(f) Encouraging the extensive cooperation among countries within a region through sharing of resources such as manpower, technical know-how, hardware and software for the projects falling in the application areas mentioned in paragraph (a) above. The regional Remote Sensing Programme (RRSP), a

project of the United Nations Development Programme (UNDP) and the Economic and Social Commission for Asia and the Pacific, is an excellent example of that;

(g) Coordination of national, regional, and international systems so as to prevent interference, especially in communications and broadcasting;

(h) Sharing of experience by the technologically developed countries with the developing countries in various fields relating to space technology and space sciences (development of satellite launching capability; designing of hardware for scientific experiments on board a spacecraft and sounding rockets etc.);

(i) Provision of opportunities and facilities by developed countries to developing countries, so that the benefits of space technology are available to all;

(j) Placement of scientists/engineers of the developing countries in the establishments located in the developed countries engaged in the space technology related activities, for their hands-on experience. Also development of a nucleus of manpower in their respective developing countries for starting, developing or promoting the activities related to practical and developmental applications of space;

(k) Wide dissemination of scientific/technical information relating to the spin-off benefits emanating from the activities of the space-faring nations in outer space and assisting developing countries in their useful applications;

(l) Joint flights by astronauts of developing countries on space stations of developed countries;

8.2 Pakistan has already announced the training opportunities for the scientists/ engineers of the developing countries in the following fields:

(i) ionospheric studies
(ii) Remote sensing applications for earth resources and environmental surveying
(iii) Design and development of ground terminals for reception of signals from direct TV broadcasting satellites.

9. Spin-off benefits of Space Activities

9.1 At present, SUPARCO has not utilized the spin-off benefits of space activities. It, however, maintains interest in developments in this field and would like the developed countries which are actively engaged in this area to share their experiences with the developing countries.